SIMULATING TRANSIENT HYDROLOGIC BEHAVIORS DURING FOREST CLEARCUT AND PINE PLANTATION WITH DYNAMIC VEGETATION GROWTH

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Forested headwater catchments respond to external disturbances and plantation through a transient adjustment of their hydrologic processes in soil and vegetation. Predicting hydrologic behaviors during this period has been a key interest for hydrologists since traditional paired-catchment experimental studies. However, few studies examined transient effect of ecosystem carbon uptake on vegetation dynamic growth and resulting hydrologic behaviors in spite of their evident eco-physiological linkage. In this study, a distributed eco-hydrologic model (RHESSys) is applied to paired experimental catchments in the Coweeta Hydrologic Lab with a dynamic vegetation growth mode. The target watershed (WS17) experienced the repetitive clearcut from 1940 to 1955 and pine-plantation from 1955, while the control watershed (WS18) has been strictly preserved from 1920s. Generalized Likelihood Uncertainty Estimation (GLUE) methodology associated with the Monte Carlo simulation is used to identify the behavioral parameter ranges within the distributed ecohydrologic modeling framework. The behavioral parameter ranges of WS18 from seventy-year rainfall-runoff data reveal that they are only related to interannual variability of precipitation patterns. However, behavioral parameter ranges of target watershed (WS17) without dynamic vegetation growth, leads to non-stationarity in parameter spaces, closely associated with its disturbance history. However, dynamic vegetation growth simulation effectively removes the externality of disturbances and internalizes its effect on behavioral parameter ranges even without specifying or calibrating a post-harvest recovery function. This study shows that how the transient hydrologic behaviors at the basin outlets are confined to current ecosystem carbon uptake and resulting dynamic vegetation growth during forest clearcut and plantation.